

CLAIMS

1. A bead molding method for molding a hollow bead from a highly viscous material that is fluid in the form of a stream in a high speed flow region and can retain a shape into which it is molded in a low speed flow region; comprising:

a gas stream forming step for forming a gas stream in a one direction;

a material stream forming step for forming a highly viscous material stream flowing in the high speed flow region within an outer peripheral space about and enclosing the gas stream; and

a bead molding step for molding the hollow bead into an irregular shape by reducing the flow speed of the highly viscous material stream from the high speed flow to the low speed flow while rendering the highly viscous material stream fluid within the outer peripheral space about and enclosing the gas stream.

2. A bead molding method for molding a hollow bead from a foamable material for forming a foamed body, comprising:

a gas stream forming step for forming a gas stream in a one direction;

a material stream forming step for forming a foamable material stream flowing in the same direction as the gas stream within an outer peripheral space about and enclosing the gas stream; and

a bead molding step for molding the hollow bead into an irregular shape by reducing the flow speed of the

foamable material stream from the high speed flow to the low speed flow while fluidizing the foamable material stream flowing within the outer peripheral space about and enclosing the gas stream.

SUB A₁

3. The bead molding method as claimed in claim 1 or 2, wherein the bead molding step molds the hollow bead into a shapes corresponding to and following the shape of the applying position by applying the work with the hollow bead or the foamable material onto the applying position while transferring the streams along the applying position.

4. The bead molding method as claimed in claim 3, wherein the hollow bead applied and molded are tackied or adhesived to the work by using the highly viscous material or the foamable material has an tackinessly or adhesive property.

SUB A₂

5. The bead molding method as claimed in any one of claims 1 to 4, further comprising a discharging device including an inner nozzle elongated at a tip portion thereof and an outer nozzle elongated about and enclosing an outer periphery of the inner nozzle; wherein:

the gas stream forming step forms the gas stream in the one direction by discharging gases from the inner nozzle; and

the material stream forming step forms the highly viscous material stream or the foamable material stream in the same direction of the gas stream about and enclosing the gas stream by discharging the highly viscous material or the foamable material from the outer nozzle.

0583443.000001

END
A2

6. The bead molding method as claimed in claim 3 or 4, wherein there is disposed a discharging device including an inner nozzle elongated at a tip portion thereof and an outer nozzle elongated about and enclosing an outer periphery of the inner nozzle;

the gas stream forming step forms the gas stream in the one direction by discharging the gases from the inner nozzle;

the material stream forming step forms a stream of the highly viscous material or the foamable material in the same direction of the gas stream about and enclosing the gas stream by discharging the highly viscous material or the foamable material from the outer nozzle; and

the bead molding step molds a hollow bead into a shape corresponding to and following the shape of the applying position by discharging the highly viscous material stream or the foamable material stream toward the work from the inner nozzle and the outer nozzle in the outer peripheral space of the gas stream while transferring the nozzles in a locus corresponding to and following the shape of the applying position.

7. A bead molding method for molding a foamed bead into a given shape, composed of a foamed body covered with a highly viscous material that is fluid in the form of a stream in a high speed flow region and retains the shape into which it is molded in a low speed flow region, comprising:

a foamable material stream forming step for forming a

stream of a foamable material for forming the foamed body in a one direction;

a material stream forming step for forming a stream of the highly viscous material in the high speed flow region in an outer peripheral space enclosing and about the foamable material stream; and

a foamed bead molding step for molding the foamed bead into an irregular shape by foaming the foamable material while fluidizing the highly viscous material flowing in the outer peripheral space of the foamable material stream and reducing the high speed flow of the foamable material stream to the low speed flow thereof.

8. The bead molding method as claimed in claim 7, wherein the foamed bead molding step molds the foamed bead into the given shape by following the shape of the applying position while transferring the foamable material stream and the highly viscous material stream along the shape of the applying position while applying the work with the foamable material and the highly viscous material.

9. The bead molding method as claimed in claim 8, wherein the highly viscous material has an tackinessly or adhesive property and the foamed bead applied and molded are tackied or adhesived to the work.

10. The bead molding method as claimed in any one of claims 7 to 9, wherein:

there is disposed a discharging device including an inner nozzle elongated at its tip and an outer nozzle elongated about and enclosing an outer periphery of the

09031453.050901

SUB A₃

0583453.050901

inner nozzle;

the foamable material stream forming step forms the foamable material stream in the one direction by discharging the foamable material stream from the inner nozzle; and

the material stream forming step forms the highly viscous material stream in the same direction of the foamable material stream and about and enclosing the foamable material stream by discharging the highly viscous material stream from the outer nozzle.

11. The bead molding method as claimed in claim 8 or 9, wherein:

there is disposed a discharging device including an inner nozzle elongated at its tip and an outer nozzle elongated about and enclosing an outer periphery of the inner nozzle;

the foamable material stream forming step forms the foamable material stream in the one direction by discharging the foamable material stream from the inner nozzle;

the material stream forming step forms the highly viscous material stream in the same direction of the foamable material stream by discharging the highly viscous material stream from the outer nozzle; and

the bead molding step molds the foamed bead in a given shape following the shape of the applying position while transferring the inner nozzle and the outer nozzle along a predetermined locus following the work by

05831453-050901

a discharging device including an inner nozzle disposed extending at a tip portion, an outer nozzle disposed extending about and enclosing an outer periphery of the inner nozzle, a first inlet connecting with the inner nozzle, and a second inlet connecting with the outer nozzle;

a foamable material feed unit for feeding a foamable material to the discharging device through the first inlet; and

a material feed unit for feeding a highly viscous material to the discharging device through the second inlet, the highly viscous material being fluid in the form of a stream in a high speed flow region and capable of retaining a shape into which it is molded in a low speed flow region.

19. The bead molding apparatus as claimed in claim 18, wherein the foamable material feed unit feeds a mixture of the gases with the highly viscous material as the foamable material.

20. The bead molding apparatus as claimed in claim 19, wherein the foamable material feed unit comprises:

a plurality of piston pumps arranged so as to perform an suction stroke and a extrusion stroke by reciprocally moving a piston in a cylinder;

a gases injection unit for supplying gases under a predetermined pressure into the cylinder; and

a formable material supplying unit for a pump control unit for controlling the plurality of the piston pumps in such a manner that each of the plurality of the piston

pumps is arranged to conduct the suction stroke for feeding gases and with the highly viscous material after the suction stroke and to conduct the extrusion stroke for discharging the mixture of the gases with the highly viscous material as the foamable material as well as that a time difference is provided for the extrusion stroke of each of the plurality of the piston pumps so as to continually discharge a predetermined quantity of the foamable material.

21. The bead molding apparatus as claimed in claim 20, wherein the foamable material feed unit further comprises a tubular path for dispersing minute bubbles of gases disposed in a discharge path of each piston pump.

22. The bead molding apparatus as claimed in any one of claims 17 to 21, wherein the discharging device is arranged so as for each of the inner nozzle and the outer nozzle to change an inner dimension of its inner wall into a smaller size over a region extending from an end portion of connection with a body of the discharging device to a tip portion thereof having a defined inner dimension.

23. The bead molding apparatus as claimed in any one of claims 17 to 22, wherein an outer wall portion of each of the inner nozzle and the outer nozzle containing an edge section at the top thereof has an inclining surface joining at an acute angle to the direction of the flow of the highly viscous material stream or the foamable material stream.

24. The bead molding apparatus as claimed in any one of

END A₅

claims 17 to 23, wherein the inner nozzle and the outer nozzle are provided, respectively, with a first control valve for controlling the opening and closing of a path reaching the inner nozzle from the first inlet and a second control valve for controlling the opening and closing of a path reaching the outer nozzle from the second inlet.

25. The bead molding apparatus as claimed in claim 24, wherein the discharging device is capable of being hand-carried; and each of the first control valve and the second control valve is capable of being opened and closed by a manual on-off operation.

26. The bead molding apparatus as claimed in claim 24, wherein each of the first control valve and the second control valve is capable of being opened and closed automatically in response to an control signal.

27. The bead molding apparatus as claimed in claim 26, further comprising:

a manipulator mounted on the discharging device at a top portion thereof and disposed so as to be movable to a desired position in response to a control signal; and

a control unit for automatically controlling the movement of the manipulator and the discharging of the discharging device in accordance with a predetermined program.

28. The bead molding apparatus as claimed in claim 27, wherein the control unit automatically controls the movement of the manipulator and the discharge of the discharging device so as to automatically apply and mold

applying position while applying the work with the hot melt material or the foamable hot melt material.

34. The bead molding method as claimed in claim 33, wherein:

there is disposed a discharging device including an inner nozzle elongated at a tip portion thereof and an outer nozzle elongated about and enclosing an outer periphery of the inner nozzle;

the gases stream forming step forms the gas stream in a one direction by discharging gases from the inner nozzle;

the material stream forming step forms the hot melt material stream or the foamable hot melt material stream in the same direction as the gas stream by discharging the hot melt material or the foamable hot melt material from the outer nozzle; and

the bead molding step forms the hollow bead into the shape corresponding to and following the shape of the applying position by transferring the hot melt material stream or the foamable hot melt material stream along a predetermined locus while discharging the gas stream from the inner nozzle and the material stream from the outer nozzle toward the work.

35. A bead molding method for molding a foamed bead comprised of a foamed body covered with a hot melt material that is fluid in the form of a stream in a middle-high temperature region and can retain the shape into which it is molded in a middle-low temperature region; comprising:

a foamable stream forming step for forming a stream

of a foamable hot melt material for forming the foamed body;

a material stream forming step for forming a stream of the hot melt material flowing in the middle-high temperature region within an outer peripheral space the foamable hot melt material stream about and enclosing the foamable hot melt material stream; and

a bead-molding step for molding the foamed bead into an irregular shape by reducing the middle-high temperature region to the middle-low temperature region while fluidizing the hot melt material stream flowing within the outer peripheral side outside and about the foamable hot melt material stream.

36. The bead molding method as claimed in claim 35, wherein the bead-molding step molds the foamed bead into a shape corresponding to and following the shape of the applying position by transferring the foamable hot melt material stream and the hot melt material stream along the applying position while applying the work with the foamable hot melt material and the hot melt material.

37. The bead molding method as claimed in claim 35 or 36, wherein:

there is disposed a discharging device including an inner nozzle elongated at a tip portion thereof and an outer nozzle elongated enclosing an outer periphery of the inner nozzle;

the foamable material stream forming step forms the foamable hot melt material stream in the one direction by

09031453-050901
105050-5541450

SUB
A₁

discharging the foamable hot melt material from the inner nozzle; and

the material stream forming step forms the hot melt material stream in the direction equal to the direction of the foamable hot melt material stream and enclosing the foamable hot melt material by discharging the hot melt material from the outer nozzle.

38. The bead molding method as claimed in claim 36, wherein:

there is disposed a discharging device including an inner nozzle elongated at a tip portion thereof and an outer nozzle elongated enclosing an outer periphery of the inner nozzle;

the foamable material stream forming step forms the foamable hot melt material stream in the one direction by discharging the foamable hot melt material from the inner nozzle;

the material stream forming step forms the hot melt material stream in the same direction as the direction of the foamable hot melt material stream and enclosing the formable not melt material by discharging the hot melt material from the outer nozzle; and

the bead molding step for molding a foamed bead into a shape corresponding to and following the shape of the applying position by transferring the material stream along a given position while discharging the foamable hot melt material and the hot melt material from the inner nozzle and the outer nozzle, respectively.

SUB A
8

39. The bead molding method as claimed in claim 37 or 38, wherein:

the discharging device is mounted on a manipulator disposed to be movable to a desired position in response to a control signal; and

the bead molding step applies and molds the hollow bead or the foamed bead automatically on the applying position of a plurality of work members being carried on a manufacturing line one after another by controlling the movement of the discharging device by means of the manipulator.

40. A bead forming apparatus for forming a hollow bead comprising:

a discharging device including an inner nozzle elongated at a tip portion thereof, an outer nozzle elongated about and enclosing an outer periphery of the inner nozzle, a first inlet connecting with the inner nozzle, and a second inlet connecting with the outer nozzle;

a gases feed unit for feeding gases to the discharging device through the first inlet; and

a material feed unit for feeding a hot melt material or a foamable hot melt material to the discharging device through the second inlet, the hot melt material being fluid in the form of a stream in a middle-high temperature region and can retain the shape into which the material is molded in a middle-low temperature region.

41. A bead forming apparatus for forming a foamed bead

03831453-050501

comprising:

a discharging device including an inner nozzle elongated at a tip portion thereof, an outer nozzle elongated about and enclosing an outer periphery of the inner nozzle, a first inlet connecting with the inner nozzle, and a second inlet connecting with the outer nozzle;

a first material feed unit for feeding a foamable hot melt material to the discharging device through the first inlet; and

a second material feed unit for feeding a hot melt material to the discharging device through the second inlet, the hot melt material being fluid in the form of a stream in a middle-high temperature region and can retain the shape into which the material is molded in a middle-low temperature region.

42. The bead molding apparatus as claimed in claim 41, wherein the first material feed unit feeds a mixture of the gases with the hot melt material as the foamable hot melt material.